PATENT ABSTRACTS OF JAPAN

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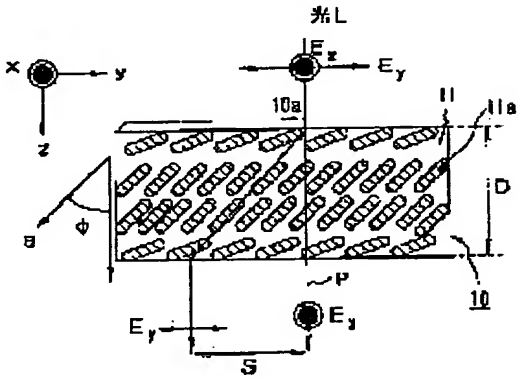
(54) POLARIZED LIGHT SEPARATING ELEMENT AND ITS PRODUCTION

(57)Abstract:

PURPOSE: To obtain a large-sized polarized light separating element by constituting the polarized light separating element of a liquid crystal film fixed with liquid crystal molecules at a prescribed angle of the angle formed by the orientation direction of the liquid crystal molecules and the normal direction of the light incident surface previously intended for the polarized light separating element.



CONSTITUTION: The polarized light separating element 10 is composed of the liquid crystal film 11 fixed with liquid crystal molecules 11 at the angle ϕ of the angle formed by the orientation direction (a) of the liquid crystal molecules 11a and the normal direction (P) of the light incident surface 10a previously intended for the polarized light separating element 10. In such a case, the liquid crystal film 11 is composed of the film formed by curing the liquid crystals having the nature to be cured by irradiation with UV rays in the state that the orientation direction (a) of the liquid crystal molecules 11a has the prescribed orientation angle ϕ with respect to the light incident surface 10a. The UV curing type liquid crystals to be used are preferably of a nematic type. The reason thereof is because the control of the liquid crystal molecules is easy in such a manner that the major axis of the liquid crystal molecules have the prescribed angle with the normal.

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CLAIMS

[Claim(s)]
[Claim 1] The polarization separation component characterized by constituting by the liquid crystal film with which the include angle of the direction of orientation of a liquid crystal molecule and the direction of a normal of the optical plane of incidence planned at the polarization separation component to make has fixed the liquid crystal molecule at the predetermined include angle.
[Claim 2] The polarization separation component characterized by being the film which stiffened liquid crystal with the property which said liquid crystal film hardens by irradiating ultraviolet rays in a polarization separation component according to claim 1.
[Claim 3] The polarization separation component by which it is being [it / the film which gave the heat history to liquid crystal with the property in which the direction of orientation of a liquid crystal molecule is fixed in a polarization separation component according to claim 1 because said liquid crystal film gives the heat history] characterized.
[Claim 4] The polarization separation component characterized by having carried out the laminating only of the number according to the polarization separation width of face from which said liquid crystal film is requested in a polarization separation component according to claim 1 to 3.
[Claim 5] The process which forms the layer of liquid crystal with the property which is hardened by irradiating ultraviolet rays in manufacturing a polarization separation component according to claim 1 or 2, The manufacture approach of the polarization separation component characterized by including the process which irradiates the ultraviolet rays of the amount which the external energy which can make the direction of orientation of a liquid crystal molecule a predetermined include angle to the direction of a normal of the optical plane of incidence planned at the polarization separation component is impressed [amount] to this layer, and may stiffen this layer in the condition.
[Claim 6] The manufacture approach of the polarization separation component characterized by removing the front flesh side of this layer until it becomes the thickness of said request after irradiating ultraviolet rays at the layer which formed the layer of said liquid crystal more thickly than desired thickness, and thick[this]-******(ed) it in the manufacture approach of a polarization separation component according to claim 5.

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DETAILED DESCRIPTION

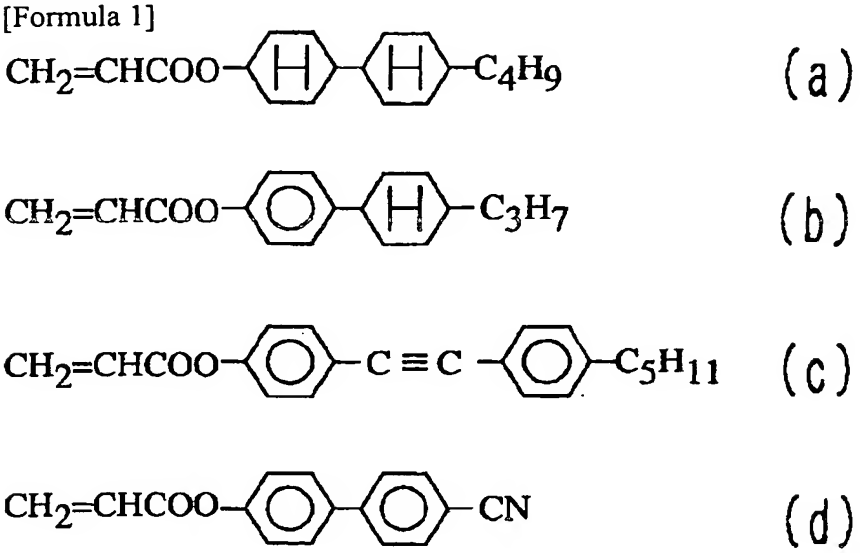
[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the polarization separation component which divides the light which carries out incidence into two polarization which intersects perpendicularly mutually, and its manufacture approach.
[0002]
[Description of the Prior Art] There is a thing using the piece of a crystal started at an angle of predetermined to the optical axis from the crystal which has the form birefringence represented by the calcite as an example of the conventional polarization separation component. Moreover, the thing of an indication is for example, in the reference I (collection C-273 of the 1994 Institute of Electronics, Information and Communication Engineers spring convention drafts) as other examples of the conventional polarization separation component. Namely, Ta 2O5 formed by slanting vacuum deposition on a quartz substrate and this substrate It is the polarization separation component which consisted of the structures which consist of the film. It is said that this polarization separation component turns into a component which shows bigger polarization part elongation than what used the calcite. It is actually Ta 2O5. Ta 2O5 vapor-deposited so that thickness might be set to 29 micrometers needlelike in the direction of 45 degrees of slant When the film is used, the polarization separation width of face of 3.7 micrometers is obtained.
[0003]
[Problem(s) to be Solved by the Invention] However, in the case of the polarization separation component using natural or artificial crystals including a calcite, since it is difficult to obtain a large-sized crystal, it is difficult [it] to obtain a large-sized polarization separation component. Moreover, although it is a crystal, since it has properties, such as reason cleavage, the polarization separation component itself will tend to become weak. Moreover, since the process of starting the piece of a crystal from a crystal, or grinding in manufacture is required, a component becomes expensive.
[0004] Ta 2O5 formed by slanting vacuum evaporationo on the other hand in order for the case of the polarization separation component using the film to make polarization separation width of face increase -- Ta 2O5 although it is necessary to form the film in still thicker thickness, ****** it cannot form so thick the film in vacuum deposition and can do -- for example, several 10- there is a problem that a throughput becomes low for forming a hundreds of micrometers thick film. Moreover, in order to manufacture a large-sized polarization separation component, large-scale vacuum evaporationo equipment is needed.
[0005]
[Means for Solving the Problem] Then, according to the first invention of this application, the include angle of the direction of orientation of a liquid crystal molecule and the direction of a normal of the optical plane of incidence planned at the polarization separation component to make is characterized by constituting a polarization separation component by the liquid crystal film which has fixed the liquid crystal molecule at the predetermined include angle.
[0006] moreover, according to the second invention of this application, as an approach of manufacturing the polarization separation component which consisted of liquid crystal film by which the include angle of the direction of orientation of a liquid crystal molecule and the direction of a normal of the optical plane of incidence planned at the polarization separation component to make

has fixed the liquid crystal molecule at an angle of predetermined Liquid crystal with the property hardened by irradiating ultraviolet rays (it may be hereafter called for short "ultraviolet curing mold liquid crystal") An approach including the process which irradiates the ultraviolet rays of the amount which the process which forms a layer, and the external energy which can make the direction of orientation of a liquid crystal molecule a predetermined include angle to the direction of a normal of the optical plane of incidence planned at the polarization separation component to this layer are impressed [amount], and may stiffen this layer in the condition is asserted.
[0007] The liquid crystal film said in these firsts and the second invention, of course shall say the liquid crystal film with which the above-mentioned immobilization is made in the condition that there is not impression of the electric field from the outside or impression of a magnetic field. Moreover, when using the above-mentioned liquid crystal film itself as a polarization separation component as constituting from liquid crystal film said in these firsts and the second invention, and when using this liquid crystal film with other elements, such as a base material, the case where this liquid crystal film is processed and used for a predetermined configuration etc. is included.
[0008]
[Function] According to the configuration of the first invention, considering the technique of a liquid crystal display, it is the liquid crystal film with which the liquid crystal molecule is being fixed in the predetermined direction of orientation, for example, the large-sized liquid crystal film of 10 inches or more of vertical angles is also obtained. And thick-film-izing of this liquid crystal film is also easy. Moreover, although it is necessary to make the electrode which specifies a switching element and each pixel from a liquid crystal display, since the need does not exist, the production of the liquid crystal film itself is simple in the case of the liquid crystal film used by this invention.
[0009] Moreover, according to the configuration of the second invention, the direction of orientation of a liquid crystal molecule can be adjusted in the predetermined direction by adjusting the reinforcement at the time of impressing external energy, such as electric field or a magnetic field, to the layer of ultraviolet curing mold liquid crystal. And since the layer of ultraviolet curing mold liquid crystal will be hardened if ultraviolet rays are irradiated in this condition, and it is fixed after the liquid crystal molecule has become a predetermined include angle to the direction of a normal of optical plane of incidence where that direction of orientation is planned at the polarization separation component, the liquid crystal film as used in the field of the first invention is obtained easily.
[0010]
[Example] Hereafter, the example of each invention of this application is explained with reference to a drawing. However, each drawing used for explanation is roughly shown in extent which can understand these invention. Moreover, the number same about the same constituent may be attached in each drawing used for explanation, and the overlapping explanation may be omitted.
[0011] 1. Explain the 1st example of the polarization separation component which is the 1st invention [first] of an example of the first invention. Drawing 1 is the sectional view having shown typically the structure of the polarization separation component 10 of this 1st example.
[0012] The include angle of the direction a of orientation of liquid crystal molecule 11a and the direction P of a normal of optical plane-of-incidence 10a planned at the polarization separation component 10 to make constitutes the polarization separation component 10 from the first invention by the liquid crystal film 11 which has fixed the liquid crystal molecule 11 at the predetermined include angle phi. And the film which stiffened liquid crystal with the property which hardens this liquid crystal film 11 by irradiating ultraviolet rays after the direction a of orientation of that liquid crystal molecule 11a has had phi whenever [predetermined orientation angle] to the above-mentioned optical plane-of-incidence 10a constitutes from this 1st example.
[0013] Here, the ultraviolet curing mold liquid crystal to be used has a desirable pneumatic mold. It is because it is easy to control a liquid crystal molecule to become a predetermined include angle to the above-mentioned normal about the major axis of a liquid crystal molecule. Although there are various such things, each liquid crystal shown by following (a) - (d) is used by this invention, and can be called example of suitable ultraviolet curing mold liquid crystal, for example. (a) That that that what is shown by the formula is indicated to be by example of a JISHIKURO hexane system and the (b) formula is indicated to be by example of a phenylcyclohexane system and the (c) formula is indicated to be by example of a tolan system and the (d) formula is an example of a cyano biphenyl

system. Anything is liquid crystallinity monoacrylate liquid crystal.

[0014]

[Formula 1]



[0015] As for each matter shown by the - (d) formula (above-mentioned [a]), what showed the ultraviolet curing property independently and mixed these two or more sorts shows an ultraviolet curing property, respectively. For example, the thing which mixed what is shown by the thing and the (b) type which are shown by the (a) formula by a unit of 50% of the weight, (a) What mixed by 1:1:1 what is shown by 33.3 % of the weight and the (c) formula in what is shown by the (b) formula 33.3% of the weight in what is shown by the formula like 33.4 % of the weight, (b) What mixed what is shown by the thing and the (c) type which are shown by the formula by a unit of 50% of the weight, (b) What mixed by 2:2:1 what is shown by 40 % of the weight and the (a) formula in what is shown by the (c) formula 40% of the weight in what is shown by the formula like 20 % of the weight shows an ultraviolet curing property. Thus, by mixing and using various ultraviolet curing mold liquid crystal, and changing a presentation ratio (mixing ratio), properties, such as the anisotropy of a refractive index or a dielectric constant, can be changed. For example, what mixed what is shown by the above-mentioned (b) formula, and the thing shown by the (c) formula by a unit of 50% of the weight shows a nematic phase at a room temperature, and anisotropy deltan of a refractive index shows about 0.15.

[0016] By the way, when it is presupposed that adjustment of the direction of orientation of the liquid crystal molecule at the time of manufacturing the liquid crystal film 11 is performed by impressing the electric field as external energy to the film in the condition of ultraviolet curing mold liquid crystal of not hardening (the term of the next manufacture approach describes for details.), The include angle of the direction a of orientation of liquid crystal molecule 11a and the direction P of a normal of optical plane-of-incidence 10a planned at the polarization separation component 10 to make is the orientation film (the term of the next manufacture approach describes for details.). Include-angle phim in the thickness direction (direction of normal) center section of include-angle, i.e., pre tilt angle, theta (refer to drawing 3 (A)) to this interface of the liquid crystal molecule in an interface with liquid crystal to this liquid crystal film 11 It is distributed continuously in between. And when the electric field which impressed the coordinate in the thickness direction of the liquid crystal film 11 at the time of z and liquid crystal film manufacture are set to E, the include angle which is probably distributed over the above-mentioned continuation target can be expressed as phi (z, E). Then, the predetermined include angle phi as used in the field of this invention should just determine by into how many phi (z, E) near the thickness direction (direction of normal) center section of this liquid crystal film 11 is made, for example, although what kind of relation it is poses a problem to this phi (z, E).

[0017] The natural light L which carried out incidence along the above-mentioned normal direction z to the polarization separation component 10 of this 1st example is the component Ex of the two polarization directions. And Ey It dissociates. And polarization component Ex of the direction of a x

axis shown in drawing 1 Penetrating as it is, the polarization component Ey of the direction of the y-axis displaces distance S S, i.e., polarization separation width of face. And this polarization separation width of face S is called for with the include angle phi (z, E) taken to the direction P of a normal of optical plane-of-incidence 10a where the direction a of orientation of liquid crystal molecule 11a in Coordinate z is planned at the polarization separation component 10, and the minute thickness dz of the liquid crystal film 11 in that coordinate neighborhood, integrates thickness D with the unit separation width of face dS, and is called for. That is, the unit separation width of face dS is given by the following (1) formula, and can express the separation width of face S with the following (2) types. ne and n0 an include angle phi (z, E) -- the direction of z -- the refractive index ne of the direction of a major axis of liquid crystal molecule 11a at the time of considering as 90 degrees (fixed) also in any, and refractive index no of the direction of a minor axis it is (refer to drawing 2) . [however,]

[0018]

[Equation 1]

$$dS = \frac{(b^2-a^2)\ \sin(2\phi(z,E))}{2\ c^2} dz \qquad \cdots\cdots (1)$$

$$a = \frac{1}{n_e},\quad b = \frac{1}{n_o}$$

$$c^2 = a^2\sin^2\phi(z,E)+b^2\cos^2\phi(z,E)$$

$$S = \int_0^D dS \qquad \cdots\cdots (2)$$

[0019] since it is easy here -- an include angle phi (z, E) -- the direction of z -- when it is assumed that all are equal in approximation, the separation width of face S called for from the above (1) and (2) types becomes equal to for example, the following (3) types of an indication in reference (Japan Society of Applied Physics optical round-table conference edit "crystal optics", 1975, p.198), and the polarization separation width of face S is called for.

[0020]

[Equation 2]

$$S = \frac{D(b^2 - a^2)}{2c^2} \sin 2\phi \quad \cdots\cdots (3)$$

$$a = \frac{1}{n_e} \quad b = \frac{1}{n_o}$$

$$c^2 = a^2 \sin^2\phi + b^2 \cos^2\phi$$

[0021] What is shown by the above-mentioned (b) formula as ultraviolet curing mold liquid crystal, and the thing shown by the (c) formula in then, the example using what was mixed by a unit of 50% of the weight and the ne and no the example which are ne =1.632 and no =1.541 -- it is -- and the include angle phi (z, E) -- the direction of z -- also in **, thickness D of the liquid crystal film 11 asks for polarization separation width of face S in 100 micrometers from the above-mentioned (3) formula in the example made into 45 degrees (fixed) in approximation also in any. Then, the polarization separation width of face S per 100 micrometers of thickness of the liquid crystal film 11 is set to 5.74 micrometers. Since it is thought that the liquid crystal film to thickness extent of 400 micrometers can be formed with the present technique, it turns out that the polarization separation component of this example can turn into a polarization separation component which used the conventional birefringence crystal, and a polarization separation component of the equivalent engine performance. In addition, the phase contrast film using the liquid crystal of an ultraviolet curing mold is proposed conventionally. However, since in the case of this phase contrast film uses for the application which cancels the refractive-index different direction of the usual liquid crystal display component, the thickness of a liquid crystal layer is liquid crystal display component extent, for example, is 10 micrometers or less. On the other hand, with the polarization separation component by this invention, in order to make polarization separate, the include angle of the direction of an optical axis of a liquid crystal molecule is thought as important, and it has a certain amount of thickness, for example, the thickness of at least 100 micrometers.

[0022] Moreover, the polarization separation width of face S0 at the time of carrying out two or more (n sheet) laminatings of the polarization separation component of this invention each polarization separation width of face of each polarization separation component of n sheets -- S1, S2, ..., Sk, ..., Sn (however, all or a part -- being the same . --) It is S0 when it carries out. =S1+S2+ ... +Sk+ ... It is given like +Sn by total of each polarization separation width of face of the used polarization separation component. Therefore, when the polarization separation width of face demanded although the polarization separation width of face of the polarization separation component 10 obtained in the above-mentioned example is Sk is Sz, it is good to prepare two or more polarization separation components concerning this invention, and to carry out the laminating of these (in the 2nd next example, it is the same.).

[0023] 2. The example which manufactures the polarization separation component of the example of the second invention, next the 1st example of the above explains the example of the second invention (invention of the manufacture approach of a polarization separation component). This explanation is performed with reference to process drawing shown in drawing 3 and drawing 4 . In addition, these Figs. show the situation of the sample in the main processes in a production process with the sectional view corresponding to drawing 1 . In addition, in this example, the example using what mixed what is shown by the above-mentioned (b) formula as ultraviolet curing mold liquid crystal, and the thing shown by the (c) formula by a unit of 50% of the weight is considered.

[0024] In this second invention, the layer of liquid crystal with the property first hardened by irradiating ultraviolet rays is formed. This is performed as follows in this example.

[0025] First, a transparent electrode 23 and the orientation film 25 are formed in this order on a glass

substrate 21. Such two substrates are prepared. however, a glass substrate 21, a transparent electrode 23, and the orientation film 25 -- what has diactinism is used for each. Hereafter, these two substrates will be called the 1st substrate 27a and the 2nd substrate 27b. next, the 1st and 2nd substrates 27a and 27b -- orientation processing of rubbing processing etc. is performed to each orientation film 25. This orientation processing is a pre tilt angle (it is desirable to carry out as [become / the include angle theta with liquid crystal molecule 11a which touches the orientation film 25 and these (refer to drawing 3 (A)) to make / large] (as highly [while / for example, / it is 0 degree < theta< 45 degrees] as possible).). Moreover, in order to make easy exfoliation with this orientation film and the liquid crystal film formed in behind, the quality of the material of the orientation film 25 is chosen, or the front face of the orientation film 25 is processed, for example with a suitable chemical. Next, ** also has the predetermined spacing D and makes the 1st substrate 27a and 2nd substrate 27b counter so that the direction of rubbing in the orientation film 25 may serve as anti-parallel, and so that the orientation film 25 may counter. Reservation of the predetermined spacing D can be performed, for example using a suitable spacer. Thus, since temporary filling of the ultraviolet curing mold liquid crystal is carried out between the 1st and 2nd substrate 27a made to counter and 27b in order to obtain the liquid crystal film 11, next, the seal of the edge of the structure which the 1st and 2nd substrates 27a and 27b were made to counter, and was obtained is carried out to a certain approach, especially the back with the 1st and 2nd approaches, for example, tape, waxes, etc. with easy dismantling of a substrate. And it is filled up with ultraviolet curing mold liquid crystal between the 1st and 2nd substrate 27a and 27b. Thereby, layer 11x of liquid crystal with the property hardened by irradiating ultraviolet rays can be formed between the 1st and 2nd substrate 27a and 27b (refer to drawing 3 (A)). In addition, in case it is filled up with ultraviolet curing mold liquid crystal, although a photopolymerization initiator (for example, Ciba-Geigy (Ciba-Geigy) IRG-651 grade) is not restricted by the suitable amount, for example, this, it is good to add about 0.5% of the weight.

[0026] Next, the ultraviolet rays of the amount which the external energy which can make the direction of orientation of a liquid crystal molecule a predetermined include angle to the direction P of a normal of the optical plane of incidence planned at the polarization separation component (refer to drawing 1) is impressed [amount] to these layer 11x, and may stiffen this film in that condition are irradiated. This processing is performed as follows in this example. First, it carries out by using the electrical-potential-difference impression means 29, and impressing electric field E between the transparent electrodes 23 which prepared impression of external energy in the 1st and 2nd substrates 27a and 27b in this example. Thereby, liquid crystal molecule 11a has and carries out orientation of the certain include angle (z, E), i.e., above-mentioned phi, to the direction P of a normal of optical plane of incidence (here the 1st, the 2nd set plate surface) where the direction a of orientation is planned at the polarization separation component (drawing 3 (B)). Of course, electric field E are impressed so that it may be set to phi (z, E) which fills the predetermined include angle phi. Next, as opposed to the sample in the condition of having impressed electric field in this way, reinforcement is 0.8 mW/cm2. Ultraviolet rays 31 are irradiated, for example for 500 seconds (drawing 4 (A)). Since layer 11x of the above-mentioned liquid crystal harden by this UV irradiation, the liquid crystal film 11 fixed by liquid crystal molecule 11a macromolecule-izing, carrying out orientation of that direction a of orientation to an include angle phi (z, E) to the above-mentioned normal direction P is obtained.

[0027] Next, it is good to perform annealing treatment to this sample. It is because it is partly recoverable that refractive-index difference deltan became a little small by the above-mentioned hardening with this annealing treatment. Although this annealing treatment is not restricted to this, for example in an inert gas ambient atmosphere, heat treatment for 20 minutes can perform it at the temperature of 150 degrees C.

[0028] Then, if the 1st and 2nd substrates 27a and 27b are removed from the liquid crystal film 11, the polarization separation component 10 of the example shown in drawing 1 will be obtained. Of course, the thing in the condition of having attached the 1st and 2nd substrates 27a and 27b may also be used as a polarization separation component.

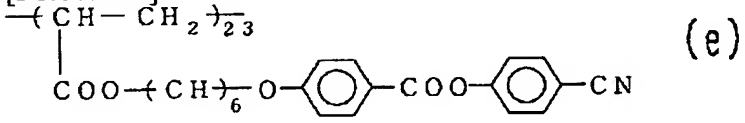
[0029] In addition, the liquid crystal film 11 hardened by the above-mentioned UV irradiation as formed [next] more thickly than the thickness of a request of layer 11x of liquid crystal by having made spacing D of the 1st and 2nd substrates 27a and 27b into D+alpha larger than D is obtained,

and you may make it remove the front flesh side of this film until it is set to thickness D of said request. If it carries out like this, the liquid crystal film part (part which is mainly concerned with the central part between the 1st and 2nd substrates 27a and 27b) which was considered that the liquid crystal film with little effect of the orientation film is obtained, and received the operation of electric field more at the time of production of the liquid crystal film can be used. Although especially the approach of removing to thickness D of a request of the liquid crystal film is not restricted, it is good for polish to remove typically.

[0030] 3. The film stiffened as predetermined constituted liquid crystal with the property which hardens the liquid crystal film 11 concerning this invention by irradiating ultraviolet rays from the 1st example of the 2nd example above-mentioned polarization separation component of the first invention. However, this liquid crystal film 11 may consist of liquid crystal film which gave the heat history to liquid crystal with the property in which the direction of orientation of a liquid crystal molecule is fixed by giving the heat history so that a liquid crystal molecule might be set to phi whenever [predetermined orientation angle]. It is because the polarization separation component which consists of the liquid crystal film with which the direction of orientation was fixed also in this case is obtained. There are various things as such liquid crystal. For example, the side-chain mold polymer liquid crystal which introduced low-molecular liquid crystal into the side chain of a macromolecule can fix the side-chain part which has liquid crystallinity according to glass transition. For example, glass transition point temperature is 31.2 degrees C, and the matter shown by the following (e) formula which is a kind of a polyacrylate system homopolymer shows a nematic phase by the liquid crystal phase. Therefore, freezing of orientation is possible by being able to carry out orientation of the liquid crystal molecule so that it may be set to phi whenever [predetermined orientation angle], and cooling it below to a glass transition point as it is by impressing electric field to it, after carrying out parallel orientation in a nematic phase.

[0031]

[Formula 2]



(e)

[0032] In order to deepen an understanding of the polarization separation component of this 2nd example, an example of that manufacture approach is explained below. This explanation is performed with reference to drawing 3 and drawing 4 .

[0033] First, a transparent electrode 23 and the orientation film 25 are formed in this order on a glass substrate 21. Such two substrates are prepared. Hereafter, these two substrates will be called the 1st substrate 27a and the 2nd substrate 27b. next, the 1st and 2nd substrates 27a and 27b -- orientation processing of rubbing processing etc. is performed to each orientation film 25. As for this orientation processing, it is desirable to carry out as [become / a pre tilt angle (the include angle theta with liquid crystal molecule 11a which touches the orientation film 25 and these to make (refer to drawing 3 (A))) / large] (as highly [while / for example, / it is 0 degree < theta< 45 degrees] as possible). Next, ** also has the predetermined spacing D and makes the 1st substrate 27a and 2nd substrate 27b counter so that the direction of rubbing in the orientation film 25 may serve as anti-parallel, and so that the orientation film 25 may counter. Reservation of the predetermined spacing D can be performed, for example using a suitable spacer. The seal of the edge of the structure which the 1st and 2nd substrates 27a and 27b were made to counter, and was obtained is carried out by a certain approach. And a liquid crystal polymer is filled up with a nematic phase between the 1st and 2nd substrate 27a and 27b. Thereby, the layer of liquid crystal with the property hardened by the heat history can be formed between the 1st and 2nd substrate 27a and 27b (refer to drawing 3 (A).). However, a liquid crystal phase is not the thing of an ultraviolet curing mold. .

[0034] Next, it cools in order to impress the external energy which can make the direction of orientation of a liquid crystal molecule a predetermined include angle to the direction P of a normal of the optical plane of incidence planned at the polarization separation component (refer to drawing 1) to this liquid crystal layer and to carry out glass transition of this film in that condition. This processing is performed as follows in this example. First, it carries out by using the electrical-

potential-difference impression means 29, and impressing electric field E between the transparent electrodes 23 which prepared impression of external energy in the 1st and 2nd substrates 27a and 27b in this example. Thereby, liquid crystal molecule 11a has and carries out orientation of the certain include angle (z, E), i.e., above-mentioned phi, to the direction P of a normal of optical plane of incidence (here the 1st, the 2nd set plate surface) where the direction a of orientation is planned at the polarization separation component (drawing 3 (B)). Of course, electric field E are impressed so that it may be set to phi (z, E) which fills the predetermined include angle phi. Next, since the layer of the above-mentioned liquid crystal is hardened by cooling the sample in the condition of having impressed electric field in this way, with the cooling rate carried out sufficiently slowly, the liquid crystal film fixed by liquid crystal molecule 11a macromolecule-izing, carrying out orientation of the direction a of orientation to an include angle phi (z, E) to the above-mentioned normal direction P is obtained.

[0035]

[Effect of the Invention] According to the first invention of this application, the include angle of the direction of orientation of a liquid crystal molecule and the direction of a normal of the optical plane of incidence planned at the polarization separation component to make constitutes a polarization separation component from liquid crystal film which has fixed the liquid crystal molecule at an angle of predetermined so that clearly from the explanation mentioned above. For this reason, since the liquid crystal film large-sized [considering the track record of a liquid crystal display] is obtained, a large-sized polarization separation component is obtained. Furthermore, the brittleness resulting from the cleavage which poses a problem by a calcite etc. is not produced. Furthermore, in production of the liquid crystal film itself, the piece of a crystal is started from a crystal, or processing and prolonged vacuum evaporationo of grinding can also be performed as it is unnecessary.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the explanatory view of the 1st example.
[Drawing 2] It is the explanatory view of the 1st example.
[Drawing 3] It is process drawing with which explanation of the example of the manufacture approach is presented.
[Drawing 4] It is process drawing following drawing 3 with which explanation of the example of the manufacture approach is presented.
[Description of Notations]
10: The polarization separation component of the 1st example
10a: Optical plane of incidence planned at the polarization separation component
P: The direction of a normal of optical plane of incidence
11: Liquid crystal film (film which stiffened ultraviolet curing mold liquid crystal)
11a: Liquid crystal molecule
D: Thickness of the liquid crystal film
a: The direction of orientation of a liquid crystal molecule
phi: Predetermined include angle
S: Polarization separation width of face

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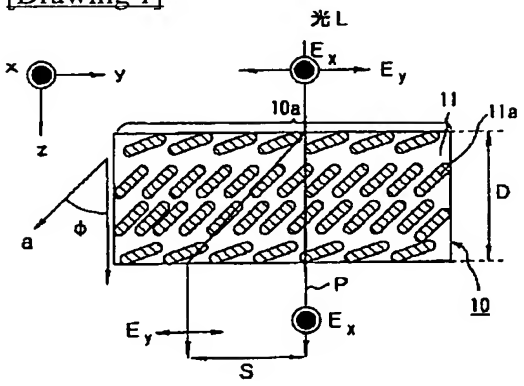
DRAWINGS

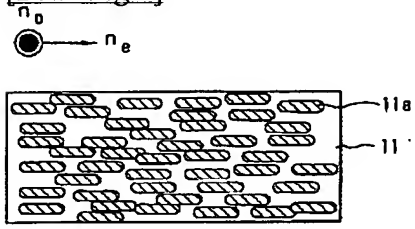
[Drawing 1]



10 ：第１の実施例の偏光分離素子
10a：偏光分離素子に予定されている光入射面
11 ：液晶膜（紫外線硬化型液晶を硬化させた膜）
11a：液晶分子
P ：光入射面の法線方向
D ：液晶膜の厚さ
S ：偏光分離幅
a ：液晶分子の配向方向
Φ：所定角度

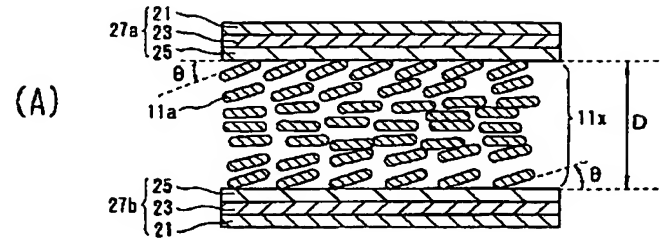
第１の実施例の説明図

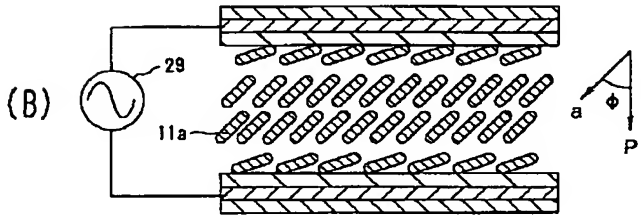
[Drawing 2]



第１の実施例の説明図

[Drawing 3]

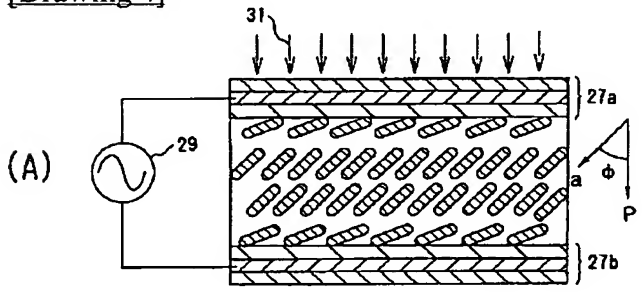


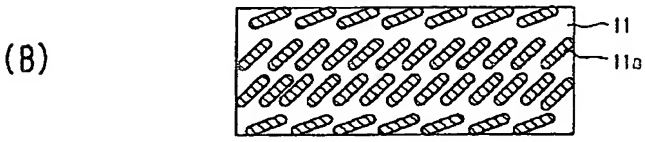


11x：紫外線を照射することにより硬化する
性質を有した液晶の層
21 ：ガラス基板　23 ：透明電極　25：配向膜
27a：第１の基板　27b：第２の基板
29 ：電圧印加手段

製造方法の実施例の説明に供する工程図（その１）

[Drawing 4]





31：紫外線（ＵＶ）

製造方法の実施例の説明に供する工程図（その２）

[Translation done.]